§ 22. Magnetic Island Formation

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Recently study of magnetic island becomes more popular in the plasma physics. LHD is one of the most suitable devices to study the physics of the magnetic island, since it can be generated and controlled by adding the n=1 field with the LID coil current. The electron cyclotron emission (ECE) is useful to observe the magnetic island structure, since the relative error is small.

The magnetic island does not appear in plasma when the electron temperature (T_e) is too high or too low in LHD. These are observed when the heating power is varied or the ice pellet is injected. Figure 1 shows time evolution of T_e profiles of LHD plasmas with the LID field before and after the hydrogen ice pellet injection. The LID current is –1200A. The island region is flat in the temperature profile. Remarkable observation is as follows: The island structure is not observed before the ice pellet injection while the LID current is large enough to produce the vacuum magnetic island structure; The island structure appears after the ice pellet injection; The island structure shrinks as the electron temperature at the island increases.

The magnetic island may not depend on the electron density. Figure 2 shows trajectories of the electron temperature at the island versus the electron density during a single discharge. This trajectory indicates that the island structure is observed in the limited region (0.2 keV < T_e < 0.8 keV) of the electron temperature at the island in any density range.

When the island is not very large, the T_e profile outside the island does not change, or the slope of the T_e profile inside the island does not change due to the island width. The island width does not depend on the β, but depends on the T_e.

It requires further investigation to understand these phenomena.

Refereneces

[1] Nagayama, Y., et al., J. Plasma Fusion Res. SERIES, Vol.5 (2002), pp.184-188.

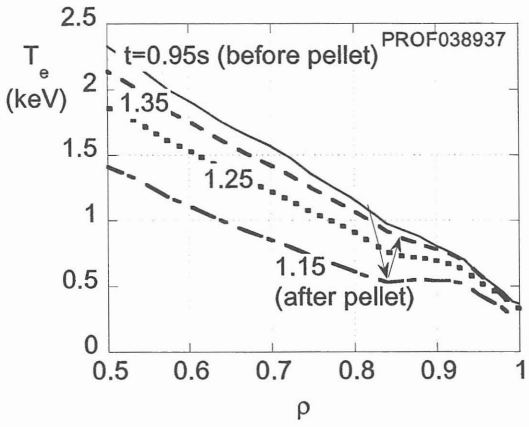

Fig. 1 Time evolution of electron temperature profiles of LHD plasmas before (t=0.95s) and after the hydrogen ice pellet injection (t=1s). Here, R_{ax}=3.6 m, B_{ax}=2.8 T, I_{LID}=-1200 A.

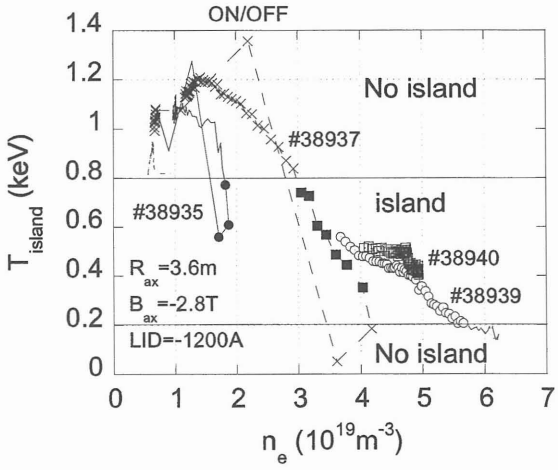

Fig. 2 Trajectories of the electron temperature at the island versus the electron density during a single discharge. The island structure is observed at the region indicated by circular or rectangular marks. Here, R_{ax}=3.6 m, B_{ax}=2.8 T.